

## RESEARCH REPORT

# Social context and depression after a disaster: the role of income inequality

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**Study objective:** To examine the association between neighbourhood income inequality and depression, both overall and among those with different levels of income, in the post-disaster context.

**Design:** A representative cross sectional random digit dial telephone survey was conducted.

**Setting:** New York City (NYC) six months after September 11, 2001.

**Participants:** 1570 respondents were interviewed, of whom 1355 provided residence information permitting their inclusion in this analysis. Past six month depression was assessed using a lay administered instrument consistent with DSM-IV criteria. Income inequality was measured with the Gini coefficient.

**Main results:** The sample was demographically representative of NYC (56.2% female, 35.7% white, 6.3% Asian 24.2% African American, 29.7% Hispanic, and 4.2% other race or ethnicity) and the prevalence of past six month depression was 12.4%. In a final adjusted model, neighbourhood level income inequality was positively associated with depression but this association was not significant ( $\beta=7.58$ ,  $p=0.1$ ). However, among those with low individual income ( $< \$20\ 000$ ) there was a strong significant association between income inequality and depression ( $\beta=35.02$ ,  $p<0.01$ ), while there was no association among those with higher income.

**Conclusions:** In the post-disaster context, neighbourhood level income inequality was associated with depression among persons with lower income; this group may be more socially or economically marginalised and dependent on local resources. Future research should examine potential mechanisms through which income inequality and other features of the social context may affect mental health in the post-disaster context.

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Although it is generally posited that the social context plays a part in shaping the consequences of disasters in populations,<sup>1–5</sup> research to date has focused on individual social factors as determinants of post-disaster mental health, including the role of social networks and social support, both generally found to protect against adverse mental health consequences of disasters.<sup>6–8</sup> To our knowledge there is no empiric epidemiological research on how features of the broader social environment may shape psychopathology after disasters.

The distribution of wealth, or income inequality, is one characteristic of the social context that could plausibly play a part in the post-disaster recovery of a population. Two mechanisms are commonly postulated to explain how income inequality could influence health in general: the psychosocial environment theory and the neo-material theory.<sup>9</sup> In brief, the psychosocial environment theory holds that perception of relative place in the social and economic hierarchy affects health through psycho-neuro-endocrine mechanisms. In addition, it suggests that perceived dissimilarity among people in unequal areas adversely affects interpersonal interactions leading to poor social cohesion. The neo-material theory states that income inequality is one of many results of historical processes that have shaped the quality and distribution of infrastructure including health, social service, and many other resources and it is the constellation of these factors that takes a toll on health. Both of these theories would suggest that after a disaster, areas with high income inequality may suffer more deleterious consequences of that disaster. In addition, certain groups living in unequal areas might be particularly susceptible in the aftermath of a disaster. For example, those who perceive their place in the social and economic hierarchy to be low may experience more stress than others in the same

area, and those who depend more on local resources may be more affected by the poor quality or lack of those resources, particularly when they are needed in the post-disaster context.

Extant research on income inequality and mental health suggests that particular groups may be more affected by the distribution of income, further implying that income inequality may be an important determinant of population health after disasters. Although general population studies have not found associations between income inequality and mental health,<sup>10–12</sup> studies of older persons and of mothers with young children, two groups that may depend on local resources more than other persons in the general population, have shown that contextual income inequality is associated with depression.<sup>13 14</sup> In the study of older persons, the association between income inequality and depression was greater among those with more physical illnesses.<sup>13</sup> In the study of mothers, the association between income inequality and depression was greater among those with low income.<sup>14</sup> In both cases, these higher risk subgroups may depend even more on resources and/or perceive their place in the social and economic hierarchy to be low. In the post-disaster setting, the potential effects of income inequality may be particularly relevant as a lack of social cohesion or paucity of material resources may exacerbate what is already an extremely difficult time. Therefore, one might expect that persons living in areas with high income inequality, which may be characterised by greater psychosocial stressors and fewer material resources, may be more susceptible to the psychological consequences of disasters.

Building on this premise, we explored the association between income inequality and depression in the aftermath of a disaster. We addressed the following study questions in a study of New York City (NYC) residents after September 11,

2001: (1) is neighbourhood level income inequality associated with depression after accounting for individual income, neighbourhood income and other demographic characteristics?, (2) are there different associations between income inequality and depression for those with different levels of income?

## METHODS

### Data

We used data from a random digit dial telephone survey of residents of the NYC metropolitan area between 25 March and 25 June 2002, roughly six months after the September 11, 2001 terrorist attacks. The study was designed to report population mental health in the aftermath of the terrorist attacks. The study included non-institutionalised adults at least 18 years of age and over-sampled residents living in the area closest to the World Trade Center site. For this analysis of NYC neighbourhoods we limited the sample to residents of NYC.

Respondents were interviewed using a structured questionnaire that assessed background and demographic characteristics including age, race and ethnicity, gender, and income. The outcome in this analysis was depression since September 11, 2001; we refer to this outcome as "past six month depression" for the remainder of the paper. Depression was measured with the national women's study (NWS) depression module, a validated measure that assesses symptoms of major depression consistent with DSM-IV criteria.<sup>15 16</sup> To meet the criteria for depression respondents had to report five or more symptoms, one of which was depressed mood or loss of pleasure or interest, each for a period of at least two weeks. Past six month depression was based on reporting the requisite five or more symptoms within the period since September 11, 2001. The depression scale, which can also be scored continuously, had a Cronbach's  $\alpha$  of 0.79 in our sample<sup>17</sup> and 0.85 in the NWS.<sup>15</sup> The brief symptom inventory-18 depression scale had 73% sensitivity and 87% specificity in detecting depression as classified by our depression instrument when examined in an earlier general population study of NYC residents.<sup>16 18</sup> The study protocol was approved by the institutional review board of the New York Academy of Medicine.

The neighbourhood units for this analysis were the 59 community districts in NYC, well defined units, each headed by an administrative community board that as such have political and social relevance for their residents. Community districts were initially defined by a resident consultative process organised by the Office of City Planning to reflect residents' own descriptions of neighbourhoods in the 1970s. Although the community districts are not demographically homogenous (as would be expected in a city as diverse as NYC), they represent neighbourhoods that have been shown to have a relation with resident behaviour and health.<sup>19-21</sup>

The neighbourhood level variables, median household income and the Gini coefficient, were calculated from 2000 US census data. The Gini coefficient measures income distribution and is calculated from a Lorenz curve with the proportion of the population from poorest to richest represented on the x axis and the proportion of the population's income on the y axis. The Gini coefficient is the proportion of the total area that falls between the diagonal line of no inequality and the concave line representing the income distribution in a particular population. Thus, a Gini coefficient of 0 denotes perfectly equitable income distribution whereas a Gini coefficient of 1.0 represents maximal maldistribution.

### Analysis

All analyses were weighted to adjust for the probability of selection for interview and for the oversample. The relations of individual income, median income, and the Gini coefficient with past six month depression were initially assessed in bivariate analysis and the shapes of these relations were used to inform the linearity of the relations for modelling. Next, the bivariate relation between the Gini coefficient and past six month depression was examined for those of low income (income <\$20 000) and higher income (income  $\geq$ \$20 000) separately. Multilevel logistic regression models were constructed with neighbourhood Gini coefficient and median income, and individual income and demographic characteristics predicting past six month depression. Models were then constructed for those of low income and higher income separately. Generalised estimating equations were used to account for potential clustering by neighbourhood.<sup>22</sup> For modelling, individual and median income measures were divided by 10 000 and all income and income distribution variables were centred and entered as continuous variables. Odds ratios (ORs) were calculated to illustrate the associations between the Gini coefficient and depression using the values of the 10th centile and the 90th centile.

## RESULTS

Overall, 1570 NYC residents were interviewed, and of these, 1355 provided residence information allowing us to link them to their neighbourhood of residence. All analyses were necessarily restricted to this latter sample and there were no significant differences between the included and excluded groups on demographic characteristics. The demographic characteristics of the sample are presented in table 1 and are consistent with demographic characteristics of NYC from the 2000 US census. Mean age was 40, 56.2% were female, 35.7% were white, 6.3% were Asian 24.2% were African American, 29.7% were Hispanic, and 4.2% were of other race or ethnicity. The prevalence of past six month depression was 12.4%.

In the 59 neighbourhoods there was a mean of 23 respondents (median = 13, range = 4-291), a mean Gini coefficient of 0.45 (median = 0.45, range = 0.37-0.51), and a mean neighbourhood income of \$38 714 (median = \$36 470, range \$16 000-\$79 475). The correlation between the Gini coefficient and neighbourhood income was -0.45 ( $p < 0.001$ ),

**Table 1** Sample characteristics, New York City 2002

	Number	%
Total	1355	100.00
Age		
18-24	144	15.95
25-34	357	27.75
35-44	279	18.33
45-54	248	18.04
55-64	148	10.95
$\geq$ 65	164	8.98
Sex		
Male	616	43.83
Female	739	56.17
Race/ethnicity		
White	682	35.65
Asian	102	6.26
African American	220	24.24
Hispanic	291	29.69
Other	40	4.15
Income		
$\geq$ \$100000	213	11.33
\$75000-\$99999	102	9.76
\$50000-\$74999	196	16.08
\$40000-\$49999	93	6.68
\$30000-\$39999	134	14.91
\$20000-\$29999	142	16.54
<\$20000	265	24.71

**Table 2** Bivariate associations with depression, New York City 2002

	Number	Past six month depression		p Value
		Depression (n)	Depression (%)†	
<b>Income</b>				
≥\$100000	213	30	8.43	0.5
\$75000-\$99999	102	17	16.26	
\$50000-\$74999	196	31	12.03	
\$40000-\$49999	93	8	9.28	
\$30000-\$39999	134	29	18.70	
\$20000-\$29999	142	16	15.94	
<\$20000	265	40	19.38	
<b>Gini coefficient*</b>				
High inequality	531	86	12.21	0.1
Medium-high inequality	451	74	18.18	
Medium-low inequality	252	24	9.73	
Low inequality	121	10	9.40	
<b>Median income*</b>				
Low income	195	35	17.65	0.05
Medium-low income	451	64	7.99	
Medium-high income	151	16	9.54	
High income	558	79	14.30	

\*Because of oversampling and differences in neighbourhood density fourths of neighbourhood characteristics do not correspond to fourths of respondents. †Percentages are weighted and thus differ from raw percentages.

consistent with the notion that although the two measures are related, they are not too collinear to model together.

In bivariate analysis the relation between the Gini coefficient and depression suggested increasing levels of depression with increasing inequality and some levelling of the effect at the highest level of inequality. However, this relation was not significant (p = 0.1) (table 2). When stratified by individual income, there was a strong relation between the Gini coefficient and past six month depression among those with low income (income <\$20 000) (p < 0.01) (table 3). There was no significant relation between the Gini coefficient and depression among those with higher levels of individual income.

In the multivariable models, median income and Gini coefficient were initially entered with squared terms to allow for the non-linearity seen in the bivariate tables. The squared terms did not attain statistical significance and thus were not retained in final models. A squared term for individual income was included in all models because of the theoretical importance of allowing a non-linear functional form for income when examining income inequality.<sup>9</sup> In a sensitivity analysis, we found no meaningful change in the final results when including an indicator for those missing income data. The demographic characteristics age, gender, and race were considered as potential confounders of the association between income inequality and depression; age and race were associated with both income inequality and depression (p < 0.2) and were thus retained in the final model to control for confounding.

The multivariable models of the association of individual income, median income, and Gini coefficient with past six month depression are presented in table 4. Gini coefficient had a positive association with past six month depression, but it was not significant (β = 7.58, p = 0.1). To examine

whether there was a stronger association between the Gini coefficient and depression among those with low individual income (<\$20 000) after adjustment for potential confounders we modelled these associations stratified by individual income (table 4). In the low income population, there was a strong association between Gini coefficient and past six month depression (β = 35.02, p < 0.01). Among those with higher levels of income there was no association between Gini coefficient and past six month depression. Among those with low income, residents of high inequality neighbourhoods had higher odds of past six month depression (OR = 3.76) and those in low inequality neighbourhoods had lower odds of past six month depression (OR = 0.27) when compared with residents of neighbourhoods with an average level of income inequality.

**DISCUSSION**

In the aftermath of a disaster, persons with low income living in neighbourhoods characterised by an unequal income distribution had higher levels of depression than those living in neighbourhoods characterised by a more equitable income distribution. To our knowledge, this is the first analysis to examine the role of income inequality in the aftermath of a disaster. However, these findings are generally consistent with prior studies in populations that may be vulnerable to the putative effects of income inequality.<sup>13 14</sup>

We had hypothesised that in the post-disaster context, neighbourhood level income distribution would be associated with depression in the general population. Although it has previously been shown that the prevalence of depression in NYC was higher in the months after September 11, 2001 than might have been expected,<sup>6</sup> we found no significant association between neighbourhood level income inequality and depression overall in the six months after September 11.

**Table 3** Bivariate associations of income inequality with past six month depression by individual income, New York City 2002

	Individual income <\$20000					Individual income ≥\$20000						
	Number	%†	Depression (n)*	Depression (%)*†	χ <sup>2</sup>	p Value	Number	%†	Depression (n)*	Depression (%)*†	χ <sup>2</sup>	p Value
<b>Gini coefficient</b>												
High inequality	207	53.45	38	17.77	36.91	<0.01	614	48.67	102	13.70	0.17	0.68
Low inequality	51	46.55	2	0.17			258	51.33	29	12.22		

\*Past six month depression. †Percentages are weighted and thus differ from raw percentages.

**Table 4** Multilevel logistic regression models predicting past six month depression, overall and stratified by individual income, New York City 2002

Parameter	$\beta$	Standard error	p Value	Individual income <\$20000			Individual income $\geq$ \$20000		
				$\beta$	Standard error	p Value	$\beta$	Standard error	p Value
Median income	-0.03	0.09	0.8	-0.34	0.33	0.3	-0.01	0.10	0.9
Gini coefficient	7.58	4.70	0.1	35.02	9.66	<0.01	0.33	4.73	0.9
Individual income	0.10	0.09	0.2	-	-	-	-	-	-
Individual income <sup>2+</sup>	-0.02	0.01	0.1	-	-	-	-	-	-
Age	-0.04	0.01	<0.01	-0.01	0.02	0.6	-0.05	0.01	<0.01
Asian†	-1.15	0.78	0.1	-1.32	1.30	0.3	-0.95	0.81	0.2
African American†	-0.91	0.41	0.03	-0.91	0.80	0.3	-0.86	0.41	0.04
Hispanic†	-0.70	0.31	0.03	-0.26	0.63	0.7	-0.72	0.35	0.04
Other†	-0.64	0.72	0.4	0.74	1.07	0.5	-1.02	0.95	0.3

\*Individual income<sup>2</sup> is individual income squared. †White race is the reference group.

Income inequality was only significantly associated with past six month depression among those with low individual income, a group that may be more vulnerable to disasters than the rest of the population.

Several of the theories that have been proposed to explain the development of psychopathology in the aftermath of disasters are congruent with the suggested mechanisms through which income inequality may operate.<sup>9</sup> For example, the diathesis-stress framework suggests that the underlying strengths and vulnerabilities of individuals or communities come into play when challenged by a disaster; psychological outcomes are determined by the ability to withstand the challenge.<sup>4</sup> The conservation of resources theory suggests that disasters have deleterious psychological effects because they deplete resources of persons and communities, both tangible and psychological.<sup>2,3</sup> The social cognitive theory views the impact of a disaster as an interaction between community, interpersonal, and behavioural factors.<sup>1</sup> All of these theories suggest that aspects of interpersonal relations and local resources related to income inequality may influence the impact of a disaster. In this analysis, we did not directly examine social cohesion or community resources, either in general or in the aftermath of the disaster. However, the results of this analysis suggest that these may be fruitful areas for future research.

### What this paper adds

- Although it is generally posited that the social context plays a part in shaping the consequences of disasters in populations, there is no empiric epidemiological research on how features of the broader social environment may shape psychopathology after disasters. The distribution of wealth, or income inequality, is one characteristic of the social context that could plausibly play a part in the post-disaster recovery of a population.
- In the aftermath of a disaster, persons with low income living in neighbourhoods characterised by an unequal income distribution had higher levels of depression than those living in neighbourhoods characterised by a more equitable income distribution.
- Groups that are more dependent on local resources or are more socially or economically marginalised may be more affected by limited availability of resources in a community and their perceived location in the economic hierarchy, both mechanisms that may explain the observed associations between income inequality and depression in the post-disaster context.

Most studies of income inequality and depression have examined geographical areas that are substantially larger than neighbourhoods, such as states, metropolitan areas, and counties.<sup>10-14</sup> In a larger area such as a metropolitan area it is easier to imagine a maldistribution of income leading to the concentration of better resources in the wealthier areas, and worse resources in the poorer areas, as proposed by neo-material theory.<sup>9</sup> In a neighbourhood, where resources are reasonably close together, it is more difficult to envision processes that would make resources in one area of the neighbourhood inaccessible to others in the neighbourhood. However, community districts are large and diverse enough that this is conceivable. In this context the social boundaries and public transportation routes within community districts may deter people from one part of the neighbourhood from accessing resources in another area. Conversely, it is easier to envision the juxtaposition of the very wealthy and very poor within one neighbourhood inducing a stress response, as proposed by the psychosocial environment theory.<sup>9</sup> This mechanism may be more plausible among these smaller areas within cities than it is at the level of a state or county.

There are several considerations important for interpretation of this analysis. The study is cross sectional so any association between predictors and outcomes cannot establish temporality. As stated earlier, we have not examined mechanisms that may explain the relation between income inequality and depression. These mechanisms are important to explore and may be better examined in a longitudinal assessment. NYC is a uniquely dense and diverse city with a wide array of levels of income inequality even at the relatively small neighbourhood level used in this analysis. Because of the singularity of this setting, the findings may not be more broadly applicable. Selection cannot be eliminated as an explanation for the results as those with low income who are predisposed to depression may differentially move to areas with unequal income distribution. This explanation seems unlikely as areas with high income inequality span a wide range of average income levels, although low inequality areas tend to be wealthier. In addition, if there were differential recall of depression symptoms by exposures of interest in this study, particularly by combinations of individual income and neighbourhood characteristics, that could explain the results found in this analysis. We used lay interviews to assess symptoms consistent with DSM-IV criteria for depression; such assessments cannot replace clinical studies in which clinicians diagnose psychopathology.

Notwithstanding these limitations, we found an association between neighbourhood income inequality and depression in the post-disaster context that merits further exploration. In particular, analyses of groups that may be more dependent on local resources or more socially or economically marginalised may aid our understanding of

the income inequality health association. This may be particularly relevant in the case of disasters, such as Hurricane Katrina that hit the Southern United States in 2005, in which the most affected groups are primarily economically disadvantaged persons. Direct examination of the available community resources and residents' experiences accessing those resources, social cohesion and perceived stress may also help clarify the mechanisms behind the associations between income inequality and mental health.

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